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Waterfowl that nest in uplands in the prairie pothole region have had low recruitment rates in recent decades, primarily because of predation. The loss of breeding waterfowl and their progeny has generated interest in management techniques that safeguard incubating hens and their eggs. Developing islands and peninsulas for nesting waterfowl has potential because these sites are naturally attractive to breeding ducks and geese. In fact, dense nesting colonies of ducks developed on some islands when successful females and a portion of their female progeny returned in subsequent years.

Managers have successfully duplicated the beneficial attributes of islands by developing various nesting habitats that are protected by water barriers. This chapter addresses the management of existing islands, the creation of new islands, and the modification of peninsulas into islands to increase nesting success in waterfowl.

Locating Manageable Islands and Peninsulas

Hundreds of natural islands and peninsulas occur in the prairies and plains of the United States and Canada. Management of islands and peninsulas is most successful here, where waterfowl populations are high and terrestrial mammals are the primary nest predators.

Many existing islands and peninsulas can be located with aerial photographs or with maps of the National Wetlands Inventory. The location of each potentially manageable island and peninsula and pertinent management information should be recorded in a permanent ledger. At each site, factors such as ownership, number of wetlands within 1 mile (1.6 km), type and area of existing nesting cover, and the classification of the present wetland should be recorded (Table).

Management of Islands

A variety of waterfowl, most notably gadwalls, mallards, lesser scaups, and Canada geese, nest on islands (Table). In addition, islands are favored as breeding habitats by some shorebird species, such as American avocets and piping plovers, and by colonial nesters, namely American white pelicans, common terns, and several species of gulls.

Site Selection Factors

The safest nesting islands are usually far from shore in large saline lakes or in open freshwater wetlands. Islands should be at least 425 feet (130 m) from shore and 300 feet (91 m) apart. This distance and separation impede travel of predators

Table. Percent species composition of waterfowl that nested on islands and peninsulas in North and South Dakota and of breeding waterfowl in the prairie pothole region, 1985–1989.

Species	Dakota breeding population	Peninsula nesting population	Island nesting population
American wigeon	6	tr	tr
Blue-winged teal	28	18	6
Canada goose	tr	tr	5
Gadwall	10	42	42
Green-winged teal	2	tr	tr
Lesser scaup	3	9	7
Mallard	17	15	32
Northern pintail	8	9	4
Northern shoveler	11	6	1
Redhead	6	tr	2
Ruddy duck	6	0	tr

between islands and reduce territorial strife between nesting pairs of Canada geese. Although wide expanses of open water deter moves of mammalian predators, large lakes may harbor gulls, which can kill small ducklings.

Saline, subsaline, or brackish wetlands provide the most suitable sites for islands with nesting habitat for ducks. For most aquatic and mammalian predators of waterfowl, saline lakes are a poor source of food and lack adequate cover. A description of saline wetlands can be found in Stewart and Kantrud (1971).

More duck nests are on islands in a wetland complex than on other islands. The most suitable island sites have 40 or more wetlands within 1 mile. Wetland complexes are best if they include seasonally flooded ponds for breeding pair habitat and semipermanently flooded ponds for broods. Nearby wetlands are particularly important to breeding birds that use islands in very saline lakes or in deep freshwater lakes, which may provide little food and cover to waterfowl.

The presence of adequate nesting cover is important. Most breeding ducks on islands nest in low shrubs (≤4 feet [about 1 m]) or in tall grasses and forbs. Densities of nesting ducks are lower on islands with tall shrubs (>4 feet [> 1 m]) and trees, such as fireberry hawthorn and American plum. Tall shrubs reduce the amount of low nesting cover that ducks seek and provide perching and nesting sites for avian predators.

Construction of Islands

Construct islands with a packed soil base for stability and a covering of ≥4 inches (10 cm) of topsoil to support vegetation for nesting cover. Put the top of the island 3 or 4 feet (about 1 m) above the average wetland level. Create a natural appearance to the island by rounding corners. Orient the long axis of the island with the direction of the prevailing storm winds to reduce erosion. Obtain details for the construction of islands from Ducks Unlimited or from Ecological Services offices of the U.S. Fish and Wildlife Service.

Spacing and size of natural islands have not been reliable biological predictors of their use by ducks, possibly because island location and the quality of nesting cover are more important factors. However, the spacing and size of islands are important economic considerations in construction because of the high costs of equipment and labor. Management is cost effective of natural islands that are larger than 0.1 acre (>0.04 ha) or of many islands at a single location. However, no more than 1 acre (0.4 ha) of islands should be built for each square mile (2.6 square km) of suitable habitat. Construction of less than 0.25 acre (<0.1 ha) islands is not advised. Small islands probably attract fewer nesting hens, their construction requires proportionately more earth than a 1-acre (0.4 ha) island, yet their annual management costs are similar. Conversely, larger than 1 acre (0.4 ha) islands are not particularly cost-effective in increasing the number of waterfowl nests.

Waterfowl in central North Dakota have successfully used small rock islands (averaging 0.006 acre [0.002 ha]). These islands are built mainly of rocks that were obtained from cultivated fields, piled in the wetland basin, and covered with soil from the wetland bottom. These islands are constructed in open water or in emergent vegetation in small prairie wetlands. Rock islands usually do not have to be seeded other than having a handful of grass–legume seeds raked into the soil.

Management of Peninsulas

The mallard, gadwall, and blue-winged teal are the predominant nesting species on peninsulas in the prairie pothole region (Table). The northern pintail and lesser scaup are secondary in importance as nesting species on peninsulas; nesting of Canada geese, colonial waterbirds, and shorebirds is negligible.

Site Selection Factors

Like islands, peninsulas for intensive management of waterfowl production should be in saline or open freshwater lakes. Such wetlands are usually free of emergent vegetation and therefore provide good loafing sites for breeding pairs of ducks but little food and cover for aquatic mammalian predators. Peninsulas should be managed in ≥2 feet (0.6 m) deep wetlands because the water barrier is present during most years and fences and moats do not have to extend far to reach >1 foot (0.3 m) deep water. Lakes for the management of peninsulas should be within 1 mile (1.6 km) of suitable wetland habitat for pairs and broods. Duck species that usually nest on peninsulas prefer moderate to tall cover, including low shrubs (<4 feet [1 m]) and grass–forb mixtures. Remove tall shrubs and trees from managed peninsulas and control all subsequent regrowth.

Because managed peninsulas attract breeding pairs from a large surrounding area, the effectiveness of management increases when sites are 1 mile (1.6 km) or farther apart. Management of peninsulas that are smaller than 2 acres (0.8 ha) is probably not cost-effective. The number of expected ducklings on these small peninsulas is too modest to justify the cost of management.

Construction of Fences

The most common barriers to predators at peninsulas are electric fences. Electric fences should extend across the base of the peninsula and into the water on each side (Fig. 1). Normally, fences have to project only 50 feet (15 m) into open water but must extend into at least 1 foot (0.3 m) deep water.

Most fences have a permanent portion on upland and an attached but removable segment in wetlands. The portion on upland is a wire barrier of 2 pieces of 1-inch (2.5 cm) mesh, 18-gauge (1.2 mm diameter of wire) poultry netting. The netting extends from 1 foot (0.3 m)

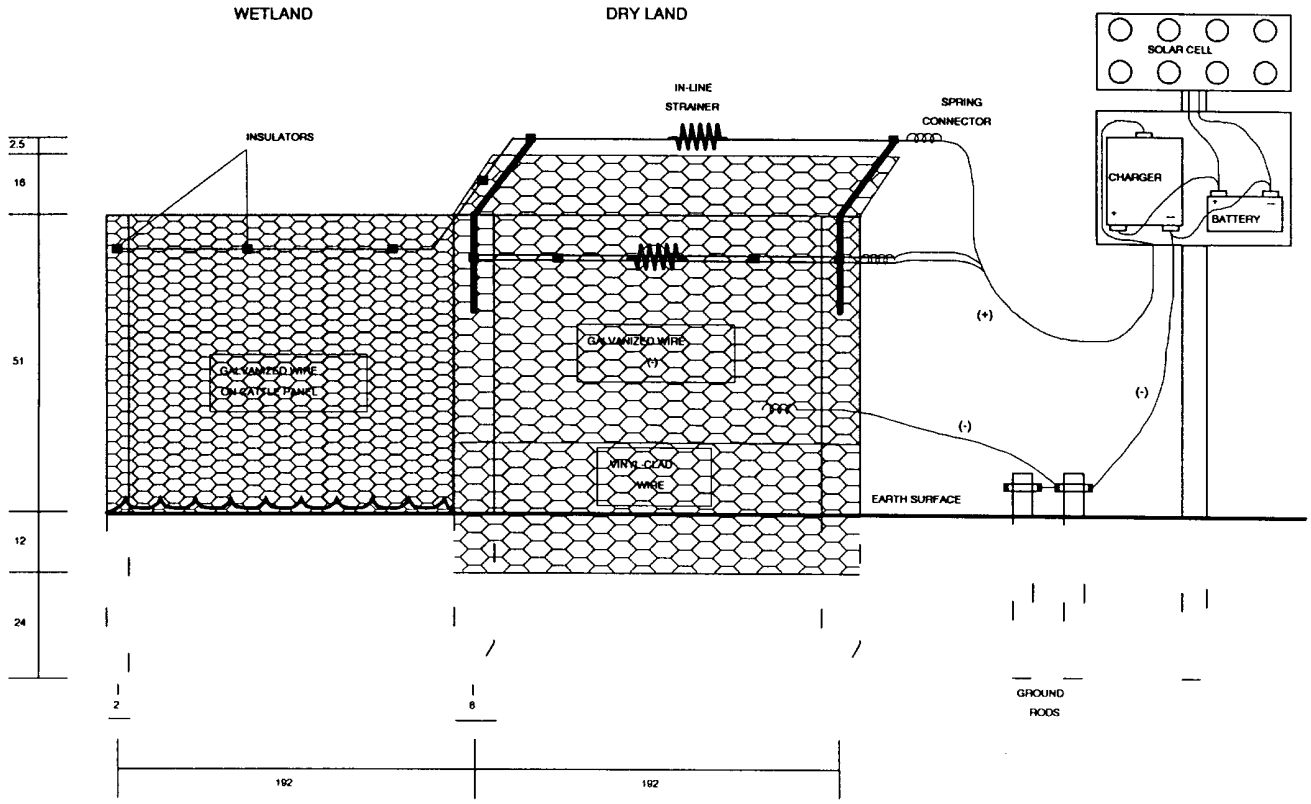

Fig. 1. A dry land section and an adjoining wetland section of an electrified barrier fence to bar access of predators to peninsulas. All measurements are in inches.

below ground to 5.5 feet (1.7 m) above ground. Use galvanized wire (which also serves as a ground) for the energized wires on the upper part of the fence. Vinyl-clad netting for the lower 2–3 feet (0.6–0.9 m) of the fence, including the 1 foot (0.3 m) below ground, retards rusting. The two wire meshes are woven together with stainless steel wire or fastened together with hog rings. In some situations a zinc-coated knotted fence or "horse fence" is used for the wire barrier. The knotted fence is more flexible for use on uneven ground and more resistant to fire. Where fire is a serious problem, a 3 foot (about 1 m) area on either side of the fence should be cleared of vegetation to prevent flames from scorching the wires.

Two 12.5-gauge (wire diameter = 2.7 mm) energized wires are attached to the side of the wire barrier facing the base of the peninsula. These wires are 4 feet (1.2 m) above ground and 2.5 inches (6.3 cm) and 5.0 inches (12.7 cm) from the poultry netting. The wires are held in place by fiberglass rods that are driven into the wooden posts and by insulators that are attached to the poultry netting. Place another energized wire 5 inches (12.7 cm) above the top of the poultry netting. To deter predators from jumping over the fence, the top 1 foot (0.3 m) should lean toward the base of the peninsula at a 45° angle. Areas without coyotes may not need the 45° overhang. Electrify wires with small high-voltage units such as the E-12 energizer made by Gallagher Power Fence, Inc., San Antonio, Texas. Power the energizer with a solar-charged battery. The poultry netting and the electric wires must be stretched tightly.

To reduce damage to the fences from water and ice, commercially available "cattle panels" (16 feet long by 4.25 feet high [about 5.0 m by 1.3 m]) of heavy steel rod can be used for the removable segment of the fence. Cover each panel with 1-inch (2.5 cm) poultry netting, and place an energized wire 5 inches (12.7 cm) above the top of the panel. The energized wire can be attached to the top of the panels by welding 1 rod to each panel, placing an insulator on the rod, and connecting the wire to the insulator. The panels can be held together by hog-rings or wire, and they can be held upright with fence posts that are driven into the wetland bottom. Extend the panels into the wetland each spring after the ice melts and remove them each fall prior to freezing. Check fences at regular intervals to repair electrical malfunctions and structural damage.

Construction of Moats

Open water moats can also be used to bar access of predators to peninsulas. Moats should have a 3:1 side slope, a ≥200 foot (61 m) width, and a ≥3 foot (≥1 m) water depth at the average wetland level. Because their construction is expensive, moats are most suitably employed at peninsulas with narrow necks because less soil needs to be moved during construction. Soil removed from the excavation is usually used to increase the size of the protected nesting habitat.

Management of Nesting Cover

On islands and peninsulas with poor nesting habitat, establish plant cover that ducks prefer for nesting. Canada geese have no specific requirements for nesting cover but prefer open sites. For nesting cover for ducks on newly constructed sites, immediately establish vegetation, which also prevents soil erosion. Grass-legume cover can be established by seeding with small grain drills after construction is completed in winter. Preferred plant species for nesting cover include intermediate wheatgrass, tall wheatgrass, and smooth brome mixed with alfalfa and small amounts of sweetclover. Grass and legume seed is available at many grain elevators and in seed houses in western states and provinces. Information on seeding rates and seeding techniques can be found in Duebbert et al. (1981).

The vigor and attractiveness of grass–legume plantings decline over time. Plant vigor can be restored by moderate cultivation. Alternatively, existing vegetation can be eliminated by spraying or plowing, and the area can be reseeded. Burning vegetation on islands is usually not recommended because fire eliminates all suitable nesting cover such as tall weeds, grasses, or low shrubs. Burning is advised only for complete restoration of cover.

Another option of establishing low–shrub nesting cover on a portion of the island is the planting of western snowberry or Wood's rose. The planting and weeding of seedling shrubs require hand labor for the first growing season. However, once established, low shrubs provide excellent nesting cover for many years. Plant low shrubs at a 2.5-foot (0.8 m) spacing during April or May after the last hard frost. Put grass–legume seedings and low shrub plantings into soil where

existing plants have been controlled by tillage or chemicals. Shrub seedlings of the described species are usually available at nurseries in most western states and provinces.

Nesting cover that has been reduced by grazing can be restored by excluding livestock with fences. Islands and peninsulas are often grazed in the fall when cattle gain access by crossing wetlands that dried out or became shallow during the summer. Exclusion of cattle may require additional fencing or an agreement with the neighboring landowner to restrain livestock. To prevent cattle damage to fences in the fall, add a low electric wire and keep the fence energized until the cattle are removed.

Management of Predators

It is crucial that skilled trappers maintain islands and peninsulas free of predators. Mammalian predators must be removed annually with quick-kill body traps set in boxes or, if necessary, leg-hold traps. Trap from the time the fences are energized or lakes become ice-free until mid-July when nesting is completed. Set traps only on the managed portion of the peninsulas and islands and not on the adjacent mainland or shoreline. Disperse traps throughout the upland habitats to capture foxes, badgers, skunks, and ground squirrels and along the shorelines to capture minks and raccoons. Most predators are trapped along the fence or moat, along the shoreline, or at natural coverts such as rock piles, dens, or tall emergent plants. During the development of a new site, the placement of 6–12 inch (about 15–30 cm) culverts along the shoreline may be useful for trapping predators. Cover the culvert with soil, but leave the ends open to provide natural pathways for minks, raccoons, and striped skunks. Small islands (<3 acres [<1.2 ha]) are often free of predators, and annual trapping may not be necessary.

In the western United States and Canada, ring-billed and California gulls nest on islands and occasionally feed on ducklings and duck eggs. Breeding gulls can be deterred from nesting on islands by establishing tall cover on potential breeding sites or by adding artificial material to bare areas.

Barrier and Island Management Costs

The average capital cost of constructing barriers in North Dakota in the 1980's was about $7,600 (mean length = 1,090 feet [332 m]) for fences and $207,000 (mean length = 2,070 feet [631 m]) for moats. The estimated cost of each fledged duck was about $12 from fenced sites and $62 from sites with moats. On existing islands where predator removal was applied, the estimated cost per fledged duckling was about $2. The cost of ducks fledged on constructed islands is the highest because of the high cost of heavy construction ($15,000–$20,000 for a 1-acre [0.4 ha] island).

A feasible strategy for identifying suitable islands and peninsulas for cost-effective management starts with the survey of the management district. First, record the location of all islands that exceed 0.1 acre (0.04 ha) and all peninsulas that exceed 2 acres (0.8 ha). Secondly, visit each site and rate its suitability for waterfowl management based on the lake, its distance from shore, and the number of wetlands within 1 mile. Rate the nesting cover and give preference to islands with low shrubs or tall grass–legume mixtures. On islands with suitable conditions for nesting waterfowl with a history of poor nesting success, only control of predators is needed. Other islands may require management of nesting cover, the addition of low shrubs or a grass-legume mixture, or the removal of tall shrubs and trees. The third most cost-effective option is the construction of electric fences at peninsulas to create island-like nesting habitat. As a final option, islands can be constructed or peninsulas modified at sites with an optimal chance for high use by breeding waterfowl and high nesting success.

Monitoring and Evaluation

Keep a permanent record about information on predators and bird nesting on islands and peninsulas (Fig. 2). Periodically conduct a survey to evaluate nesting and nesting success by waterfowl on islands and peninsulas. Techniques for searching for nests and evaluating nesting success can be found in Klett et al. (1986).

ISLAND [ ] OR PENINSULA [ ] SURVEY

Physical Information

Name_____ No._____ Size (Ac)_____ Wetland Size (Ac) _____

Site Tn _____ N, Rg _____ W, Sec _____, Qtr _____ Town_____

Wetland (Stewart & Kantrud 1971) Class _____ Sub-Class _____ Cover Type _____

Dist. to Near Shore (Ft)_____ Ownership (FWS,BLM,BOR,STA,PRI) _____

Shoreline Vegetation(%) Bare_____ Grass _____ Emergent _____ Forb _____

Low Shrub (<3')_____ Tall Shrub (> 3')_____ Tree _____

Upland Vegetation (%) Bare _____ Grass _____ Emergent _____ Forb _____

Low Shrub (<3')_____ Tall Shrub (> 3')_____ Tree _____

No. Wetlands within 1 Mile _____ Wetland Acres within 1 Mile _____

Predator Information

Yr	Mo	Day	Species	No. Seen	No. Scats	No. Tracks

Nesting Bird Information

Yr	Mo	Day	Species	No. of Nests	% Suc.

Fig. 2. Suggested form for recording data on islands and peninsulas with nesting habitat for waterfowl.

Suggested Reading

Duebbert, H. F., E. T. Jacobson, K. F. Higgins, and E. B. Podoll. 1981. Establishment of seeded grasslands for wildlife habitat in the prairie pothole region. U.S. Fish and Wildlife Service Special Scientific Report—Wildlife 234. 21 pp.

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Appendix. Common and Scientific Names of the Plants and Animals Named in the Text.

Plants	
Tall wheatgrass	*Agropyron elongatum*
Intermediate wheatgrass	*Agropyron intermedium*
Smooth brome	*Bromus inermis*
Fireberry hawthorn	*Crataegus chrysocarpa*
Alfalfa	*Medicago sativa*
Sweetclovers	*Melilotus* spp.
American plum	*Prunus americana*
Wood's rose	*Rosa woodsii*
Western snowberry	*Symphoricarpos occidentalis*
Animals	
Northern pintail	*Anas acuta*
American wigeon	*Anas americana*
Northern shoveler	*Anas clypeata*
Green-winged teal	*Anas crecca*
Blue-winged teal	*Anas discors*
Mallard	*Anas platyrhynchos*
Gadwall	*Anas strepera*
Lesser scaup	*Aythya affinis*
Redhead	*Aythya americana*
Canada goose	*Branta canadensis*
Coyote	*Canis latrans*
Piping plover	*Charadrius melodus*
California gull	*Larus californicus*
Ring-billed gull	*Larus delawarensis*
Striped skunk	*Mephitis mephitis*
Mink	*Mustela vison*
Ruddy duck	*Oxyura jamaicensis*
American white pelican	*Pelecanus erythrorhynchus*
Raccoon	*Procyon lotor*
American avocet	*Recurvirostra americana*
Ground squirrels	*Spermophilus* spp.
Common tern	*Sterna hirunda*
Badger	*Taxidea taxus*
Gray fox	*Urocyon cinereoargenteus*
Red fox	*Vulpes vulpes*

Note: Use of trade names does not imply U.S. Government endorsement of commercial products.

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